Paper ID: 84187
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22nd IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Space carrying capacity assessment and allocation (10-E9.4)

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ASSESSING ORBITAL CAPACITY WITH A SPACE OCCUPANCY MODEL

Abstract

A considerable research effort in the last two decades has been devoted to study the evolution of the space debris and active satellites environment as a means to avoid its degradation and to continue to exploit space as a key resource for mankind. Concepts such as environmental criticality, space carrying capacity and space sustainability rating have been proposed in order to monitor the health of the space environment and coordinate space traffic management. This will in the end aid policy-makers develop space use regulations and organise future space debris removal operations. One primising approach to assess the current space carrying capacity and minimize its future degradation is to monitor the shell density of resident space objects (RSOs) by accurately modelling how their altitude fluctuates over a given time span under the action of all relevant orbital dynamics perturbations. In this work, we show how these fluctuations are related to a recently proposed "space occupancy" concept and can be evaluated analytically based on a full-zonal perturbed two body problem model and using RSOs initial conditions from tracking data. In addition, we propose new indicators to evaluate the degree of crowding of individual orbits for the current RSOs population as well as its historical evolution starting from twoline elements data. The results are discussed and compared to previous contributions in the literature.